Written Testimony of
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For the Hearing
The National Windstorm Impact Reduction Act of 2004

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Introduction

Chairman Ehlers, Chairman Smith and distinguished members of the Subcommittees:

I appreciate the opportunity to testify on behalf of the National Science Foundation (NSF) concerning H.R. 3980 -- the National Windstorm Impact Reduction Act of 2004, and NSF's robust research in this area. In order to provide context for the NSF involvement in windstorm research, let me first discuss the broader NSF mission in order to place in context my extended discussion of the role of NSF.

The NSF Mission

Recent years have seen an acceleration in rates of change in society and in the world at large. In this era of dynamic change, in which science and technology play an increasingly central role, NSF has remained steadfast in pursuit of its mission: to support science and engineering research and education for the advancement of the nation's well being. Knowledge is our strongest insurance for preparedness. The Foundation is the main source of funding for the growth in fundamental scientific and engineering knowledge and, at the colleges and universities funded by NSF, scientists and engineers are working to provide ever more effective approaches for prediction and for prevention and mitigation of impacts of natural hazards including windstorms.

The investments made by NSF are critical to creating a complete picture of the nation's vulnerability to windstorms – an understanding that leads to effective mitigation and hazard reduction. Collectively, the directorates of NSF cover the spectrum from natural and social sciences to engineering, from discovery to implementation, from prediction to response to mitigation. With the vulnerability of the nation to natural hazards growing and becoming increasingly complex, it is important to have an integrated, multi-agency perspective to make significant progress. Fortunately, such agency partnerships are already in existence.

NSF and Current Support for Windstorm Impact Reduction Research

Windstorm and hazards-related research and educational activities are supported by many programs at NSF, including particular contributions from the Social, Behavioral, and Economic Sciences (SBE), the Geosciences (GEO) and the Engineering (ENG) Directorates. Estimated program investments in windstorm-related research at NSF are summarized in the table below for the past two fiscal years. Please note that these investment totals do not include a large body of research on, for example, heavy rains in hurricanes and thunderstorms, or portions of related infrastructure support (e.g. base support for national facilities such as radars, aircraft, computing centers).

NSF Directorate	Focus	FY2002 ($million)	FY2003 ($million)
Geosciences (GEO)	Windstorm	5.6	9.1
	Related (estimated)	3.2	4.8
Engineering (ENG)	Wind	3.3	4.7
	Multi-hazard Related (estimated)	2.0	2.8
	Social Science	1.3	2.3
Social, Behavioral and Economic Sciences (SBE)	Social Science	0.4	0.5
Biological Sciences (BIO) Computer and Information Sciences and Engineering (CISE) Education and Human Resources (EHR) Mathematical and Physical Sciences (MPS)	Wind and Multi-hazard Related	3.5	7.7

Fundamental windstorm research is funded in GEO, while ENG supports fundamental research into multi-hazard engineering that includes engineering design for wind impacts. Social science research related to hazard mitigation and preparedness is supported through the SBE and ENG Directorates. Significant progress continues to be made in these programs in understanding windstorm processes, impacts, and the social and economic aspects of hazard reduction. NSF investments result not only in new knowledge and facilities, but also in the supply of trained researchers and professionals that the nation needs.

NSF investments have supported growth of vibrant and integrated hazards-related research communities in engineering, geosciences, and in the social sciences. Leadership from the engineering, social science and geoscience research communities has been important to transfer of research outcomes into application, engineering practice and into improvements in codes and standards. Related NSF activities include programs involving wind research facilities, post-windstorm investigations, international cooperation, and information dissemination. Throughout the remainder of this testimony, recent highlights of such NSF activities will be presented.

Engineering programs support basic research into structures and their performance under loading from hazards that include earthquake, wind, hurricanes and tornadoes, fire, blast and other forms of non-static loading. Over the past three years, the number of proposals that were submitted in these research areas has doubled. The research is basic in nature, and projects are selected based on merit determined through rigorous peer review by experts.

Awards for wind-related research have included CAREER awards to young faculty, and other projects in which faculty study wind issues including wind forces, structural response and projectile damage. In addition, ENG supports reconnaissance studies of tornado and hurricane damage, equipment and facility development, and workshops or meetings to bring the research community together to discuss research issues. Examples of current work include the first full-scale study of the behavior of tall buildings under wind, underway at Notre Dame; a study of wind-structure interaction for low-rise buildings, underway at Florida Atlantic University; study of tornado-induced wind loads on structures, underway at Iowa State; and study of the performance of large coastal bridges under hurricanes, being conducted at LSU. In addition several studies aimed at developing new ways of monitoring structural performance are active, as are studies developing new damping or other technologies designed to reduce the effects of windstorms on structures.

Since FY2000, basic research with a special focus on buildings has been supported through the joint NSF/HUD PATH (Partnership for Advanced Technologies in Housing) program. The main research areas explored in this program have been:

- New window materials that will reduce damage structural and collateral damage due to flying debris,
- Lightweight wall systems that have improved wind and projectile resistance,

- New technologies for retrofitting incorporating new materials such as Fiber Reinforced Polymers, and
- Robust structural and roofing systems.

The PATH program has also given particular attention to the protection of critical buildings such as school buildings.

Research in atmospheric sciences is strongly supported at NSF, including fundamental research on the structure and lifecycle of tornadoes, hurricanes and windstorms. An example of NSF's investments is the FY2003 sponsorship of the field phase of the Bow Echo and Mesoscale Convective Vortices Experiment (BAMEX). A focus of the BAMEX is the study of long-lived severe storms that produce damaging straight-line surface winds. The BAMEX project conducted detailed aerial and ground surveys of wind damage following bow echo events and will use this information to relate the severity and scale of damage to radar-observed convective system location and structural characteristics as well as perform analyses and mesoscale model simulations of bow echo events. BAMEX was conducted over a large experimental domain centered on St. Louis, Missouri, and involved unprecedented data collection via specialized airborne and ground-based observing platforms. The results of this research will significantly clarify the understanding of damaging wind production in bow echoes and will illuminate where the most damaging winds are most likely to occur, with what radar-observable attributes, and under what mesoscale environmental conditions. Ultimately, results may be applied by operational forecasters to issue more timely and accurate forecasts and warnings of damaging nontornadic surface winds.

In addition to engineering and atmospheric sciences, NSF supports social, economic, and behavioral science research on windstorm and related hazards through both the Engineering and the SBE Directorates. The research currently focuses upon such critical issues as the mitigation of hurricane losses through effective coastal and land use management; improvement in warning systems for short-fuse weather phenomena, such as tornadoes; more effective hurricane evacuation planning; improved urban search and rescue operations for collapsed structures resulting from hurricanes and tornadoes; and greater resilience and recovery of communities in the post hurricane and post-tornado environment. Research and practice indicate that adoption of effective, non-structural coastal hazard mitigation programs with their accompanying land-use controls over the coming decades will significantly lower property losses. The control of coastal development, developing effective warning and evacuation systems, and improving emergency planning and response in coastal and wind-prone areas cannot be ignored if loss reduction is to be achieved.

NSF also supports windstorm-related research through other directorates including BIO, CISE, EHR and MPS. Research foci include post-storm ecological damage and recovery, mathematical modeling of weather and coastal processes, and K-12 and informal science projects. Such investments in recent years have totaled on the order of \$4 to \$8 million per year.

Research at NSF Centers

NSF's centers programs provide very useful institutional arrangements for conducting complex holistic research. In 1989, the NSF Science and Technology Centers program began support for the Center for Analysis and Prediction of Storms (CAPS) at the University of Oklahoma (OU) in collaboration with the National Oceanic and Atmospheric Administration (NOAA). Since its establishment, CAPS has developed techniques for the numerical prediction of small-scale weather, especially aimed at substantially increasing the accuracy and reliability of warnings of hazardous weather associated with thunderstorms. NSF core support for CAPS ended in 2000, and the Center has continued to be a dynamic center conducting innovative research and expanding partnerships to include many federal and state agencies and public and private organizations. It also acts directly in service to the public – for example, in an effort to learn as much as possible about every aspect of the May 3, 1999 Great Plains Tornado Outbreak, CAPS organized a National Symposium that was convened with NSF funding. This conference brought together more than 400 meteorologists, social scientists, construction engineers, emergency managers, policy makers, and disaster relief workers from around the world in the first multi-disciplinary examination of a major tornado disaster. More than 1000 private citizens attended a half-day exhibition of safe room and advanced weather technology prior to the symposium.

Current weather forecasting and warning technology uses data from high power, long-range radars that have helped meteorologists improve forecasts significantly in the past 10 years. However, long-radars have limited ability to observe the lower part of the atmosphere because of the Earth's curvature. Today's radars cannot detect the full vertical rotation of most tornadoes, and they cannot observe tornado behavior at or near ground level. In addition, one in five tornadoes is undetected by current technology, and 80% of all tornado warnings turn out to be false alarms.

Last year, NSF began funding a new Engineering Research Center (ERC) - the Center for Collaborative Adaptive Sensing of the Atmosphere, or CASA. The CASA ERC is a partnership between the University of Massachusetts (lead institution), University of Oklahoma (including CAPS researchers), Colorado State University, University of Puerto Rico at Mayaguez, and a consortium of industrial partners and NOAA's National Severe Storms Laboratory. CASA is researching a new weather hazard forecasting and warning technology based on low-cost, dense networks of radars that operate at short range, communicate with one another and adjust their sensing strategies in direct response to the evolving weather and changing end-user needs. In contrast to today's physically large radars that have 30 foot diameter antennas, the antennas in the CASA networks are expected to be three-feet in diameter with electronics that are about the size of a personal computer. This small size allows these radars to be placed on existing cellular towers and rooftops, enabling them to comprehensively map damaging winds and heavy rainfall in the critical region beneath the coverage of current technology.

In addition to providing low-level coverage, this approach is expected to achieve breakthrough improvements in sensitivity and resolution leading to significant reductions in tornado false-alarms; fine-scale wind field imaging and thermodynamic state estimation for use in short-term numerical forecasting and other applications such as flood prediction and airborne hazard dispersion prediction. A new generation of meteorological software will be developed to use this radar data to support emergency managers and government and private industry organizations that need weather data for making critical decisions.

The team is configured to lay the fundamental and technological foundations for dense, adaptive radar networks and conduct proof-of-concept demonstrations using field-scale test beds deployed in hazard-prone areas. Research projects include the design and fabrication of low-power solid state radars, new hazard detection algorithms that make use of the data, and the design of the system architecture for organizing hardware and software components and interfacing to end-users. The first test-bed, comprising a network of nine small radars, will be installed beginning September 2005 on towers across central and western Oklahoma in a region frequented by tornadoes and severe thunderstorms. An end-user group comprised of emergency managers and public and private sector weather forecasters is included in the CASA team and will participate in the testing of the system.

Information Technology for Windstorm Research

Each year across the United States, floods, tornadoes, hail, strong winds, lightning, and winter storms cause hundreds of deaths and result in annual economic losses of more than $13B. Their mitigation is stifled by rigid information technology frameworks that cannot accommodate the unique real time, on-demand, and dynamically-adaptive needs of weather research.

Linked Environments for Atmospheric Discovery (LEAD), is an ITR (Information Technology Research) project started last year. The aim of LEAD is to create a series of interconnected virtual "Grid environments," that allows scientists and students to access, prepare, predict, manage, analyze, and visualize a broad array of meteorological information independent of format and physical location. A transforming element of LEAD is the ability for analytical tools, forecast models, and data repositories to function as dynamically adaptive, on-demand systems that can change configuration rapidly and automatically in response to the evolving weather; respond immediately to user decisions based upon the weather problem at hand; and steer remote observing systems to optimize data collection and forecast/warning quality.

LEAD will allow researchers, educators, and students to run atmospheric models and other tools in much more realistic, real time settings than is now possible, hasten the transition of research results to operations, and bring the pedagogical benefits of sophisticated atmospheric science tools into high school classrooms for the first time. Its capabilities will be integrated into dozens of universities and operational research centers that collectively reach 21,000 university students, 1800 faculty, and hundreds of operational practitioners.

Status of Understanding About Windstorms and Impacts, and Future Research Directions

Engineering knowledge about windstorms and their effects on manmade structures is still developing. Engineering practice relies on basic understanding of winds and simplified models to represent loadings on structures. However, the state of practice is such that most large buildings and many large bridges are wind tunnel tested at reduced scale to determine wind loads and performance. Wind tunnel test results permit improved design solutions for wind over those possible with analytical models. NSF has funded projects to improve testing facilities at a number of institutions, including a recent award to design and build a wind tunnel at Iowa State. For this and other facilities, NSF advocates shared use of data and facilities by the community to permit collaborative research and an integrated approach to wind research.

Experimental data from wind tunnel testing has been an important ingredient in the development of improved design procedures, and such approaches will no doubt be an element of future research. This empirical approach works, but the solutions are largely case-specific and difficult to transfer to other designs or to generalize. With the development of and easy access to sophisticated simulation models and high-end computational resources, NSF expects there to be rapid innovations in the analysis of complex structures or facilities located in complex environments.

Knowledge of basic questions such as wind speeds in hurricanes and tornadoes is still being developed. During Hurricane Isabel, one NSF-supported team from the American Association of Wind Engineering (AAWE) observed that in the Williamsburg area of Virginia, large trees were uprooted and blown down in some areas but not in other adjacent areas. Empirical data strongly suggests that the wind speeds at the hurricane front are not uniform, but have significant spatial variation. This observation is important because it suggests that the “conventional” engineering wisdom for wind distribution is too simplistic. Because current field wind-measurement instruments are limited in capability and not widely distributed, it has been difficult to gather meaningful data concerning spatial variability of wind forces and directions. With rapid development in sensors and wireless and deployable sensor networks, we can anticipate a near-term improvement in our ability to make distributed measurements. Such work will lead to significant advancements in engineered design for windstorm impacts.

Open questions in Wind Engineering include

- magnitude and distribution of wind forces on structures in actual severe windstorms
- effects of severe non-uniform transient winds on structures
- effects of scale in the predicted effects of steady and transient windstorms on structures
- development of computational models to predict structural loading from extreme wind events based on next generation experimental work
- development of improved reliability models based on transient wind studies
- effects of the loss of building envelop integrity on windstorm damage

Regarding the atmospheric sciences, significant progress has been made over the last decade in fundamental understanding of the basic characteristics of the structure of tornadoes and their parent thunderstorms. Progress also has been made on the detection of thunderstorms that have the potential to be tornadic and, to a lesser extent, their prediction. Knowledge of the triggering mechanisms for the tornadic vortex itself is still lacking. Primary research thrusts today are in the triggering mechanism of the tornadic vortex and better short-range prediction (0 to 6 hours) of tornadic thunderstorms with an emphasis on thunderstorm initiation.

While the prediction of hurricane tracks has improved over the last decade due to better understanding of the controlling physical factors, errors in track location are still large. Research in this area continues. Little progress has been made on understanding and forecasting hurricane intensity changes. Current research thrusts focus on the impact of internal storm dynamics and air/sea/land interactions on wind intensity changes. As explained in the context of the BAMEX project, the study of the physical forcing mechanisms of straight-line winds from severe storms has been a major research thrust area. Knowledge of the physical factors that control severe straight-line wind episodes is rudimentary at this time.

Prior and ongoing research sponsored by NSF has been quite successful at determining the fundamental physics of microburst wind events, which have been shown to be responsible for many aircraft accidents. While research on microbursts continues, much knowledge has been transferred to the operational communities (FAA and NOAA) and much ongoing research is supported by the FAA. Overall, NSF supported research on this topic is decreasing.

Research into coastal zone management, which has the goal of removing property from the direct impacts of hurricanes, and research on warning and evacuation, which has the goal of removing people from vulnerable areas, are extremely cost-effective, non-structural activities that significantly reduce the losses from windstorm impacts. With the future development of sensor networks, distributed information technology and cyber resources, NSF anticipates that these areas of research will develop rapidly.

Most NSF awards are made for support of unsolicited research proposals submitted to disciplinary or cross-disciplinary research programs. These proposals are peer-reviewed by experts who are well-appraised of priorities identified by the research communities, and submissions are evaluated by established merit criteria. NSF also works directly with research communities through support of workshops and conferences to identify research priorities and opportunities. A few examples of such activities follow.

For example, NSF supported a Workshop in February 2004, conducted at the University of Central Florida for identifying the critical needs in the housing industry. In addition to the academe-based researchers involved in NSF/HUD (PATH) research initiative, expert attendees including architects and industrial representatives were invited to identify research areas that will improve safety, identify innovative construction techniques and develop products that will compete in international market. One of the focus areas was safety and security against natural and man-made disasters. Fire, wind and earthquake were identified as the critical safety areas for natural disasters. For wind, prioritized research foci included innovations to improve the performance of roof and frame connections and the shatter resistance of glass, and the use of sensors for warning and self-activation of safety measures.

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Interagency Activities of NSF in Disaster Reduction

NSF functions by the peer review process and works under the direct input of researchers from the community. As such the mission of NSF is complementary to, but apart from, the more mission oriented efforts of other Federal agencies. NSF is very eager to support the research community in doing high quality basic research and works with other Federal agencies within this context.

NSF is engaged with other Federal agencies in several activities. With NIST, NSF co-supports the Joint Wind and Seismic Task Group to the U.S./Japan Natural Resources Development Program (UJNR). In reconnaissance efforts, NSF has direct contact with FEMA to ensure that NSF-supported efforts complement FEMA efforts and do not cause problems with emergency response and recovery. NSF also works to involve other federal agencies in research workshops as participants or as co-sponsors.

This Bill designates that an Interagency Working group be formed to include NSF, NOAA, NIST, FEMA and other agencies. In fact, these agencies are represented on the Subcommittee on Disaster Reduction (SDR) of the NSTC (National Science and Technology Council). NSF is a strong supporter of strategic planning efforts by SDR agencies in order to further interagency coordination and integration, and NSF has taken a leadership role in preparing a forth-coming SDR report documenting “Grand Challenges” for hazards reduction research.

NSF works closely with other weather agencies in the conduct of many research efforts. A primary coordinating mechanism is the interagency U.S. Weather Research Program (USWRP), which is focused on the study of “high impact” weather (life threatening and/or economically significant weather events). Much of NSF-sponsored hurricane research and the BAMEX were conducted under the USWRP umbrella.

The results of NSF research are carried forward into implementation through the involvement of the researchers themselves in professional organizations, and through activities managed by our sister agencies. In this respect, NSF funding enables a knowledgeable research community to be prepared to answer questions posed by windstorm events themselves, and by observations of the performance of the built environment and sociopolitical systems during and after storms events. NSF-funded research enables changes warranted in engineering practice, and enhances understanding and assessment of risks and uncertainties in natural, physical, and social environments.

Since 1976 the NSF has supported the work of the Natural Hazards Research and Applications Information Center (NHRAIC) at the University of Colorado at Boulder. The NHRAIC serves as a national and international clearinghouse for research on all types of hazards, including hurricanes, tornadoes, and other wind-related phenomenon. The NHRAIC convenes an annual meeting that includes workshop activities, and serves as a bridge between researchers who produce hazard-related knowledge, and the users of that knowledge. It links those engaged in the study of wind-related hazards and disasters with government officials, policy-makers, emergency managers, and the public. The annual budget for the NHRAIC is about $850,000. Of that total, NSF contributes $300,000. The remainder of the funds are supplied by other federal agencies, such as FEMA, NOAA (including the weather service), U. S. Geological Survey (USGS), DOT, NASA, EPA, and the Centers for Disease Control (CDC).

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Two other issues are of interest to NSF regarding windstorm impact reduction: Workforce and international activities. I will briefly describe some of NSF’s activities in these areas.

Workforce Issues in Windstorm Impact Reduction

The initiation and eventual institutionalization of fields of inquiry is heavily dependent upon generational cohorts of scholars who not only produce new knowledge but also produce new generations of scholars who will continue to develop the field. NSF makes specific investments to support workforce development in all areas – including atmospheric sciences, engineering and hazards reduction. The following cases serve as examples of such investments.

The Directorate for Engineering has made an award entitled “Enabling the Next Generation of Hazard Researchers: An Education and Training Proposal“ to the University of North Carolina, Chapel Hill. The project responds to a serious issue in the field of research on societal aspects of extreme events: the lack of an adequate cohort of junior faculty to sustain scholarship into future generations. This education and training initiative addresses this issue by developing a comprehensive, creative program of mentoring for recently appointed junior faculty at research universities.

NSF has also funded an Integrative Graduate Education and Research Traineeship (IGERT) award to Texas Tech that is aimed at producing a cadre of professionals prepared with multidisciplinary backgrounds and the technical and professional needed for the career demands in wind science and engineering, and associated economics/risk management. The program provides an integrated program that crosses the disciplines of atmospheric science, engineering, and economics leading to an interdisciplinary doctoral degree. Some of the research areas are wind characteristics in tornadoes and landfalling hurricanes, post-disaster investigation of building damage and economic losses, deign criteria for shelters, full-scale building response in the field, wind tunnel studies, simulation of damage, forecast for wind power, and hurricane evacuation.

At NCAR (National Center for Atmospheric Research) at the University of Colorado, Boulder, the Directorate for Geosciences supports a program entitled “Significant Opportunities in Atmospheric Research and Science” or SOARS. This program offers summer research internships to undergraduates exploring a career in an atmospheric science or related field such as biology, chemistry, computer science, earth science, engineering, environmental science, mathematics, meteorology, oceanography, physics, or social science.

At the Oklahoma Weather Center (OWC), NSF supports a long-standing summer Research Experience for Undergraduates (REU) program. This program addresses the general lack of opportunities for undergraduates to gain research experience to complement their academic careers, and also the lack of participation by women and members of ethnic minorities in research in atmospheric science. The OWC in Norman boasts a unique environment that encompasses all aspects of meteorological research and can provide students with the opportunity to enhance their undergraduate careers.

International Collaborative Research

The National Science Foundation aims at nothing less than U.S. world leadership in science, engineering, and technology. Hurricanes, tornados and other windstorms are global hazards. Many countries find collaborative research and the sharing of information essential in meeting this challenge and the U.S. is no exception. NSF has a long history of cooperating with other countries. For example, NSF supports and participates in the NIST-managed U.S./Japan Joint Panel on Wind and Seismic Effects that convenes annual meetings for information exchange, and NSF has supported U.S academic participation in a sequence of U.S.-Japan Workshops on Design for Wind and Wind Hazard Mitigation. An outcome of these workshops is an increased level of cooperative activity between the U.S. and Japanese wind communities. Many international research thrusts on weather topics are coordinated through the World Weather Research Program of the United Nations’ World Meteorological Organization.

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In closing, let me make a few observations concerning the proposed legislation. The bill would establish an Interagency Working Group to include NSF, NOAA, NIST, FEMA and other agencies as appropriate. The purpose of this Working Group would largely be planning and coordination, but a mechanism for such activities already exists through the Subcommittee on Disaster Reduction (SDR) of the National Science and Technology Council (NSTC), and this mechanism is working well.

The proposed legislation also directs the establishment of a National Advisory Committee on Windstorm Impact Reduction. In fact, federal agencies involved with windstorm impact mitigation regularly receive guidance from academic, government and industry sectors through professional societies, meetings, and workshops. These same agencies also support the Disasters Roundtable activity of the National Academies. Such input is very valuable to establish important research directions, and an additional advisory organization would replicate these activities.

Finally, the proposed legislation defines a specific program for windstorms and mandates activities for research, impact assessment, and impact mitigation. It requires the development of an implementation plan and biennial reporting. NSF supports basic research, not research to address specific goals or priorities as might be appropriate for a sector-specific or mission agency. The hallmark of NSF’s success is its openness to unsolicited proposals to highly competitive programs. These proposals undergo a thorough merit review by experts according to defined criteria, and the most meritorious research is funded.

Although we welcome Congressional attention and oversight in this area, we are always concerned about the unintended consequences of codifying research programs into law. While we look forward to working the Committee to implementing the goals of this legislation, the Administration believes that it is unnecessary to enact this legislation at this time.

Mr. Chairmen, thank you again for the opportunity to present this testimony. NSF is very excited about what NSF research investments have accomplished to date, and about what will be possible to achieve in the future.

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Significant Opportunities in Atmospheric Research and Science (SOARS): http://www.ucar.edu/soars/
Linked Environments for Atmospheric Discovery (LEAD): http://lead.ou.edu/
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John A. Brighton began his tenure as Assistant Director for Engineering at the National Science Foundation on April 30, 2003. Immediately prior to this appointment he served as Provost of National-Louis University. He previously served as Chair of the Teaching and Learning Consortium at The Pennsylvania State University from July 1999-June 2002. Brighton also served Penn State as Executive Vice President and Provost from July 1991-June 1999 and Dean of the College of Engineering from 1988-1991.

He was Director of the School of Mechanical Engineering at the Georgia Institute of Technology from 1982-1988, and was Chairman of the Department of Mechanical Engineering at Michigan State University from 1977-1982. Prior to taking a position at Penn State in 1965, Brighton served as assistant professor of Mechanical Engineering at Carnegie-Mellon University.

Brighton was also instrumental in helping Penn State University deal with change through the principles of continuous improvement. The University Council on Continuous Quality Improvement was appointed in 1991 and the University CQI Center was established in 1992.

In 1994, Brighton established the Women in Sciences and Engineering Institute to enhance recruitment and retention of women students and faculty in these disciplines. At Penn State, he received awards from the University Commission for Women and The University Committee on Diversity. He is a Fellow of the American Society of Mechanical Engineers, and of the American Society for Engineering Education. He served on the Advisory Committee for NSF's Engineering Directorate, and also as Chairman, Council of Deans of the ASEE.

Born in Gosport, Indiana, Brighton received his B.S., M.S., and Ph.D. in Mechanical Engineering from Purdue University. His research was focused on the structure of turbulent fluid motion, biofluid mechanics and research related to the development of the artificial heart and heart assist devices.